Broadband Internet Technology Development and Challenges

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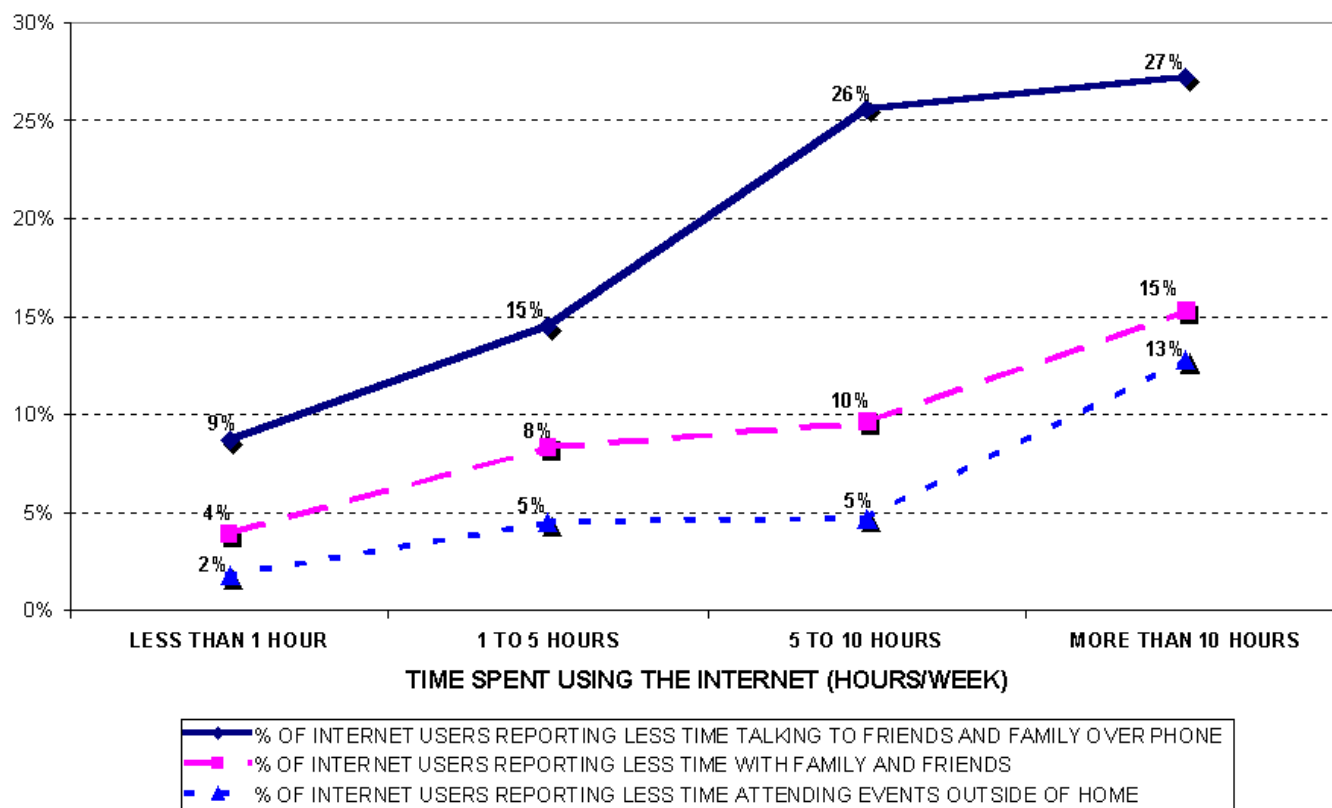
National Broadband Initiative 16th April 2010

Drivers for Broadband

Plethora of services causing Internet traffic to grow 50% every year

Sacrificing what – Lesser Traditional Social Interaction ?

SOCIAL ISOLATION INCREASES

Legend:
- % OF INTERNET USERS REPORTING LESS TIME TALKING TO FRIENDS AND FAMILY OVER PHONE
- % OF INTERNET USERS REPORTING LESS TIME WITH FAMILY AND FRIENDS
- % OF INTERNET USERS REPORTING LESS TIME ATTENDING EVENTS OUTSIDE OF HOME

TIME SPENT USING THE INTERNET (HOURS/WEEK)

Source: Stanford

But….socializing on Internet

Major Drivers

- **Social Networking**
  - Peer to peer applications dominate
- **Multimedia intensive**
  - Interactive video, mobile TV, on-line gaming
- **Heterogeneity of Devices**
 - Desktops, Laptops, PDA, Handhelds
  - Small sensors, actuators

What are their impacts?

- **Traffic Models and Usage Behavior altered**
  - Peer to peer applications has different traffic profile
  - Effect on paradigms of network design
- **Resource Allocation**
  - QoS requirements need new ways of allocating resources
- **Network Modeling**
  - Massively large telecom graph
    - WebGraph
- **Security**
  - Content regulation

Now what??

- **Edge**
  - Broadband Wireless
- **New QoS Paradigm**
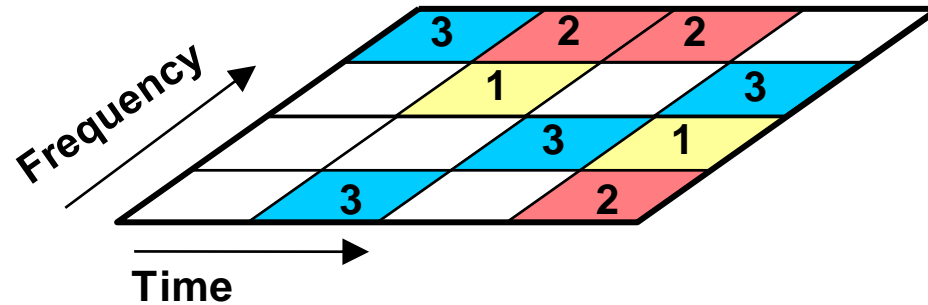- **Storage**
- **Security**

Wireless Broadband at Edge
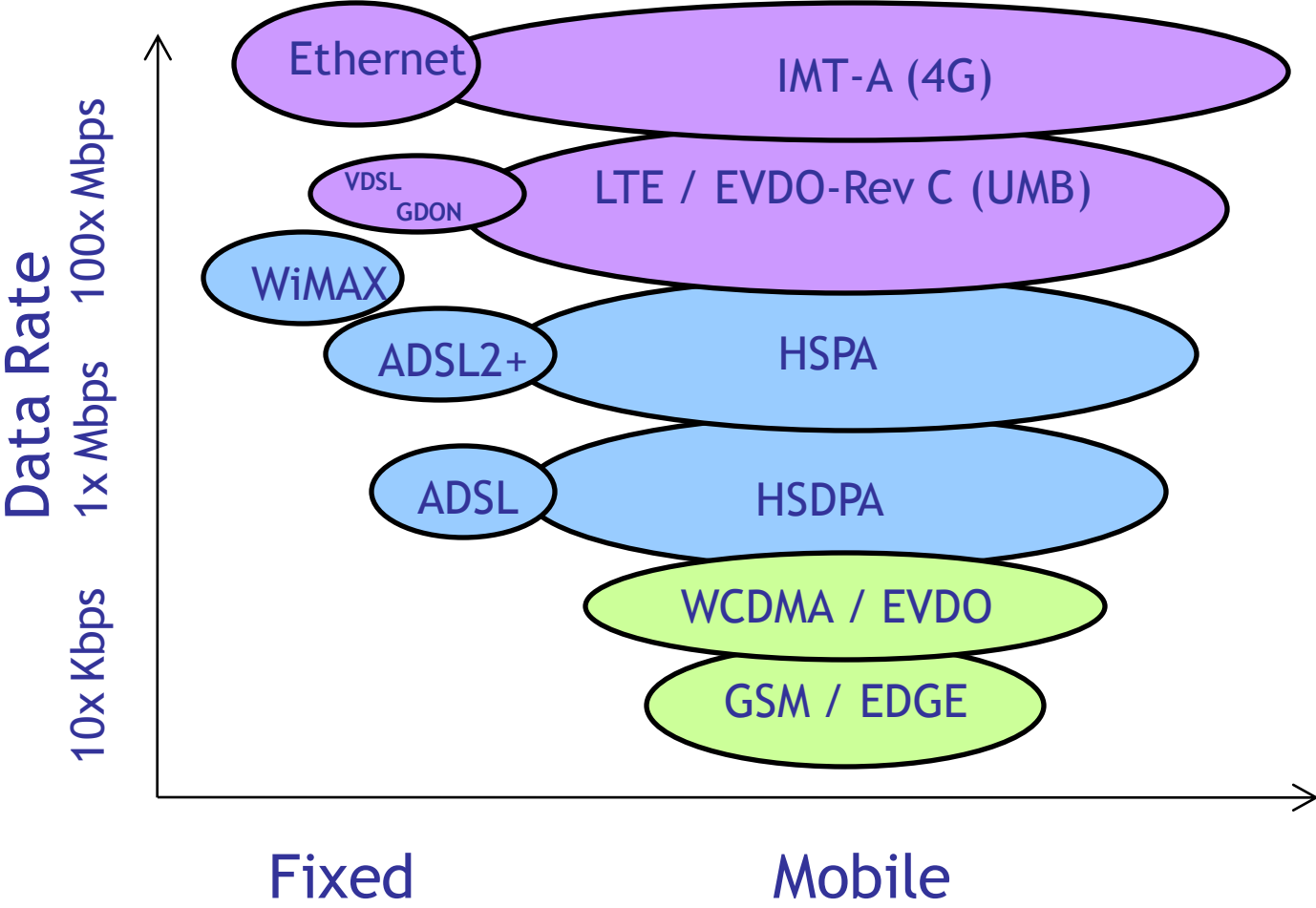
IMT-Advanced = 4G = Broadband Wireless

- **Peak Spectral Efficiency**
  - 15 bps/Hz - DL
  - 6.75 bps/Hz UL
- **Operating Bandwidth**
  - 5 to 100 MHz
- **Cell Edge Spectral Efficiency**
  - 0.06 bps/Hz - DL
  - 0.03 bps/Hz - UL
- **Mobility (bps/Hz at Km/hr)**
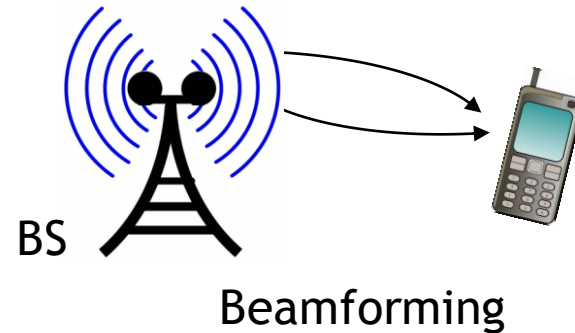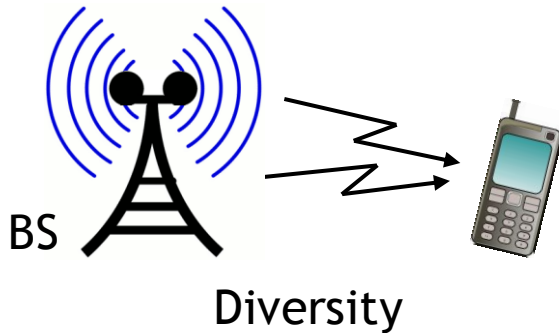 - 0.55 at 120 Km/hr
  - 0.25 at 350 Km/hr

- **Latency**
  - Control plane < 100 ms
  - Data plane < 10 ms
- **VoIP Capacity**
  - 40 active users / MHz / sector
- **Spectrum (IMT Bands)**
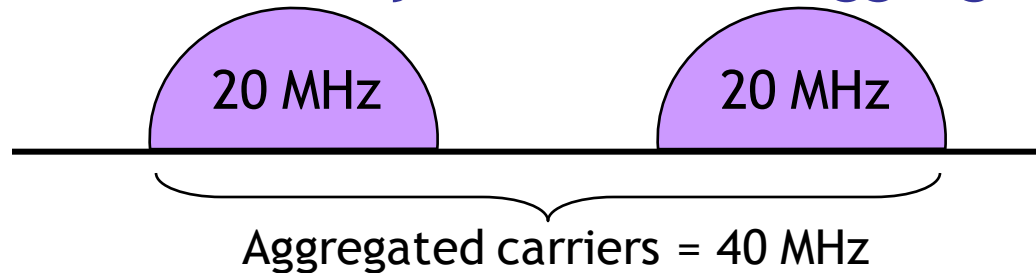 - 450 – 3600 MHz bands

Technology Components for 4G
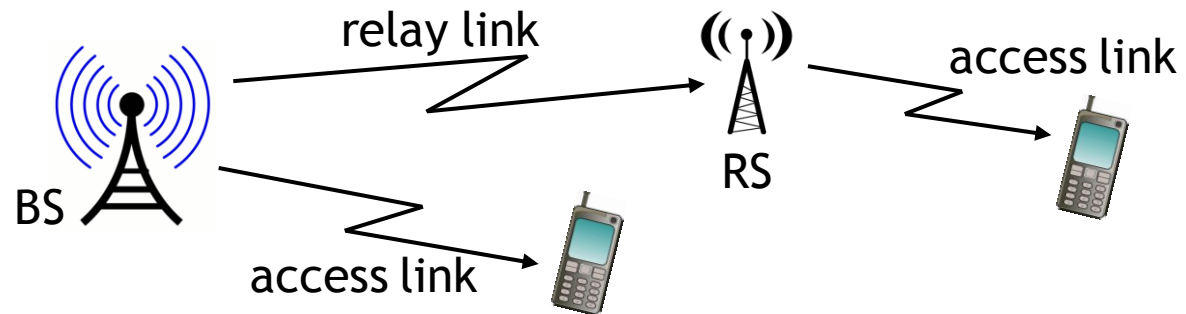
- **OFDMA**

- **Multi-Antenna (MIMO)**

BS   Diversity

BS   Beamforming

Technology Components for 4G

- **Spectrum flexibility and Carrier aggregation**

| 20 MHz | | 20 MHz |

Aggregated carriers = 40 MHz

- **Relaying**

relay link   access link

BS   RS

access link

- **Coordinated Multipoint transmission**
  - Geographically distributed antennae coordinate

Technology Components for 4G

- **Enhanced Quality of Service support**
  - End to End delay optimization

- **Self organization and Self optimization**
  - Plug and Play form of operation

SON will play a major role in 4G Wireless Broadband in India

New QoS principle required

- **P2MP traffic with interactivity**
  - Should be possible to offer any single TV channel from anywhere in the world - which cable-TV cannot offer
- **HDTV quality demand more resources**
- **VoD and Digital Video Recorder has removed any restrain on the user**

New Design Principles required for managing QoS

New Storage Requirement

- **Content servers being saturated or overloaded**
  - Operators providing many local cache
- **Circulation of contents from one cache to another**
  - zonal-time-difference, language, newness of the content
- **Fiber bandwidth will get exhausted soon!**

New Paradigms in Storage Required

New Security Challenges

- **Packet based radio access pose new challenges**
- **Security infrastructure need to be scalable**
  - Peer to peer applications- each user is a potential broadcaster of (un)regulated information
- **Content regulation and ownership**
- **Challenges for legal intercept**

Conclusions

- **Broadband Internet –particularly wireless broadband has many challenges**
  - Traditional traffic models and design no longer valid- new paradigms needed
  - Creation and dissemination of multimedia contents – new framework
- **Heterogeneity of devices, storage, security and servers posing other challenges**
- **Major shift in policy also required**